system in whorls. They reach the surface of ridges which appear as papillæ because they are cut across at regular intervals by the longitudinal ciliary grooves.

The morphology of this neuromotor apparatus shows that it is well adapted to coordinate the movements of the animal because the organelles of feeding, locomotion, and defense are all connected by a system of conductile fibers to a presumably coordinating center. Furthermore the fibers must be either supporting, contractile, or conductile. Their exceeding fineness indicates the unlikelihood of a supporting function. Their position with respect to the neuromotor center makes it unlikely that they are contractile because those, the main direction of which is longitudinal, would have to operate antagonistically to those whose direction is transverse. The only alternative is that the fibers are conductile.

Three experimental methods, that of staining by micro-injection, the determination of the axial gradient in solutions of narcotics (Child, 1915), and micro-dissection (Taylor, 1920) were used to secure additional evidence pointing towards a neuromotor function of the fibers.

Experiments with the first method were negative. An axial gradient was easily demonstrated, indicating the presence of conductile elements. A high rate of metabolism in the region of the neuromotor center could not be demonstrated, however, because *Paramecium* did not disintegrate as do annelid worms and planarians in the solutions used.

Cutting the cytopharyngeal fibers resulted in the loss of coordinated movement of the cytopharyngeal membranelles. Extensive destruction of tissue in the region of the neuromotor center resulted in the loss of coordinated movement of locomotor organelles. Equal destruction of tissue elsewhere in the body did not destroy coordinated movement.

Thus, while experimental evidence is less conclusive than the morphological it supplements the latter in demonstrating that the fibers of *Paramecium* have a conductile function.

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

SECTION OF LEATHER CHEMISTRY
John Arthur Wilson, *chairman*
G. D. McLaughlin, *secretary*

Color measurement of vegetable tan liquors: HENRY RICHARDSON PROCTER.

The color value of a tan liquor as a function of the hydrogen-ion concentration: JOHN ARTHUR WILSON and ERWIN J. KERN. The color value of a tan liquor depends upon its hydrogen-ion concentration when used. A change in pH value produces a change in color of both liquor and leather. Tan liquors change in color like indicators with change in pH value, but over a range of from 3 to 12. This change in color is completely reversible, if the liquors are not long exposed to air. Liquors exposed to air continue to darken in color, the more so the higher the pH value, but this change is not reversed by lowering the pH value. Liquors exposed to air at pH values of about 9 give bulky precipitates when their pH values are brought to 3 and such liquors tend to poison the hydrogen electrode.

Chemical and physical behavior of gelatin solutions: JACQUES LOEB.

The equilibria between tetrachrome collagen and liquors of different chrome content: ARTHUR W. THOMAS and MARGARET W. KELLY.

The adsorption of the constituents of chrome liquor by hide substance during nine months contact and the equilibria between tetrachrome collagen and various concentrations of liquor: ARTHUR W. THOMAS and MARGARET W. KELLY. Previously a tetrachrome collagen was considered the most complex chrome collagen compound obtainable. In this research an octachrome collagen was prepared. Further it was established through study of the change in composition of tetrachrome collagen in contact with liquors of different concentrations over a period of nine months that the reactions taking place in chrome tanning are chemical in nature. This paper is one of a series of contributions from this laboratory establishing the chemical nature of the combination of chromium with hide to form chrome leather.

Influence of sodium chloride, sodium sulfate and sucrose on the combination of chromic ion with hide substance: ARTHUR W. THOMAS and STUART B. FOSTER. Until four years ago it was considered that the only important features involved in the use of chrome liquors in chrome tanning was the percentage of chromium and

sulfuric acid and their ratio one to another. The researches by Wilson and Kern, of Milwaukee, and by this laboratory have demonstrated that many simple substances hitherto considered without any influence may have a profound effect on the process of chrome tanning. In this research effects of the substances mentioned in the title have been carefully studied and a chemical theory has been propounded which involves the formation of addition compounds. The recognition of the existence of such compounds will be required for proper control of chrome tanning.

Differentiation between physical mixtures and chemical compounds: JEROME ALEXANDER.

Effect of acidity upon the rate of diffusion of tan liquor into gelatin jelly: JOHN ARTHUR WILSON and ERWIN J. KERN. As ordinarily used in tanning, gambier and quebracho extracts show marked differences in the rate of tanning and of penetration into the hide. It is shown that the rate of penetration is a function of the hydrogen-ion concentration as well as of the nontannin content. A sample of gambier penetrated the jelly only at pH values above 3.0, but a sample of quebracho only at pH values above 4.7. Above 9.0 the quebracho penetrated more rapidly than the gambier. The shape of the interface between a tan liquor and gelatin jelly was also found to be a function of the hydrogen-ion concentration.

Theory and use of electrometric titrations: HAROLD FALES.

The chemical constituents of skin: F. L. SEYMOUR-JONES. Animal skin consists of proteins, fats and mineral salts, but for the tanner only the former are of much importance. Proteins occur in nature in the colloid state, a state of matter hitherto somewhat obscure in that it appeared impossible to apply normal chemical laws thereto. Professor Procter, of Leeds, and his collaborators, in particular Mr. J. A. Wilson, for many years studied the swelling of gelatin in acids and finally succeeded in showing that it followed a definite course which could be represented by mathematical expression. Dr. Loeb, of the Rockefeller Institute, has carried this further in studying the effects of different acids, alkalies and salts on gelatin and other proteins, and has shown that, taking into consideration the hydrogen-ion concentration (hitherto neglected), proteins really follow ordinary chemical laws. Of the proteins of hide, the most important is collagen, which is undoubtedly closely allied to gelatin. Elastin is most stable, but for light leathers is generally removed in the bating process. It is highly elastic under very small stresses. For keratins the tanner has little use, and their removal is one of his objects. The interfibrillary cementing substance is usually removed in liming; it is probably a mucoid, but its exact nature is still doubtful. A thorough knowledge of the chemical constituents of skin is essential if progress is to be made in the science of tanning. So far progress has been slow in this direction, but each advance materially aids in increasing knowledge and possibilities of further advance.

The warble fly problem: ALFRED SEYMOUR-JONES. The warble fly is one of nature's pests, ruining hides by its numerous perforations. The fly lays its eggs on the hairs on the legs of cattle; from here the maggot hatches and bores into the animal's body. In order to prevent or cure this plague, the English, Scottish and Irish agricultural authorities set up a scientific committee to deal with the question. Squeezing the warble bots out of the backs of a herd of isolated cattle during five years proved successful, but this would scarcely be feasible on a large scale. Next a mixture of bird lime material and birch tar oil was painted on the hind quarters of some cattle, but, though this might have prevented the flies from laying their eggs, the cattle's tails stuck to the tacky material and they stampeded. A great variety of mixtures, to be applied to the cattle's backs when the maggots are nearly ready to emerge, have been tried. Some give 80 to 96 per cent. kills, but the work is as yet incomplete. However, applied to *all* cattle in an area for two or three years, there is reason to hope that the fly might be exterminated.

Properties and action of enzymes in relation to leather manufacture: J. T. WOOD. Enzymes do not merely accelerate a change already in progress, but actually cause it. An explanation is given of Armstrong's view of the two-fold action of enzymes. The action of hydrolytic enzymes is caused by the increase of hydrogen-ion or hydroxide-ion concentration at the surfaces of their particles. The action of enzymes in the various processes of leather manufacture was discussed. In the "soaks" enzymes are secreted by a variety of species of bacteria, as is also the case in the "limes," but the possibility of the presence of tissue enzymes in these two processes should not be overlooked. The enzymes of the dung bate are then enumerated and a short account of the introduction of commercial enzymes is given. The action of tryptic enzymes on the elastin of the grain and Wilson's experiments are briefly discussed together with the author's views

of the interpretation to be put upon the results. In the "drenching process" the presence of an amylolytic enzyme is essential. Starches are transformed into dextrin and glucoses, which are subsequently fermented into organic acids.

A critical study of bating: JOHN ARTHUR WILSON and GUIDO DAUB. A critical study of bating limed skins in the tannery has been made which tends to elevate a heretofore mysterious process to a scientific plane. The primary function of bating is to remove elastin fibers from the skin prior to tanning. This is done by means of pancreatin after liming, unhairing and washing the skins. When a dilute solution of pancreatin was employed, complete digestion of the elastin was effected only when the pH value of the solution lay between 7.5 and 8.5, but when a more concentrated solution was used, the active range was extended to 5.5 to 8.5. An explanation of this is given on the assumption that an addition compound between the enzyme and collagen is formed in increasing amounts as the pH value is reduced from .8. The rate of removal of elastin from calfskin is shown as a function of the concentration of enzyme and of the time of digestion. Ammonium chloride shows an activating effect in concentrations up to 0.5 gram per liter and a marked inhibitory effect in higher concentrations. The failure of commercial bates to remove elastin from calfskin was attributed to the presence of woody fibers. A comparison of bated and unbated leathers was made. The work was illustrated by five photomicrographs and four sets of curves.

The microscope as applied to leather manufacture: FINI ENNA.

The isoelectric point of collagen: ARTHUR W. THOMAS and MARGARET W. KELLY. Recent expemental work in biological chemistry has demonstrated that proteins are amphoteric electrolytes in aqueous solution. The point of transition in their amphoteric properties is known as the isoelectric point, a knowledge of which is essential in interpretation of their chemical and colloid chemical conduct. Hides and skins consist of proteins, the protein collagen predominating. It is obvious that the amphoteric nature of hide protein plays an important rôle in tanning the hide. The object of this research was to determine the isoelectric point of hide protein and thus contribute to the chemical control of leather manufacture. The experiments enumerated in the paper show the isoelectric point to be at a hydrogen-ion concentration of 10^{-5} moles per liter. At acidites higher than this, the hide is electropositive and at lower acidities, or greater alkalinities it is electronegative.

Physiological and histological observations on the flayed skin entering into the art of leather manufacture: ALFRED SEYMOUR-JONES. Before proceeding with the animal skin, the tanner first removes all the hair and outer skin (epidermis) from the outside and all adhering fleshy matter from the inside of the skin. This leaves the true skin to be converted into leather. This true skin consists of four distinct layers. The topmost layer is the grain membrane, which varies considerably in feel and texture with different animals. It forms a connecting link between the epidermis and the true skin. Just below it lies a thin layer, the *cutis minor*, vitally important in the manufacture of good leather. Below again is the fatty layer, largely consisting of groups of fat cells, resembling in appearance bunches of grapes. The last layer is the *cutis major*, which forms the major part of the whole skin. It is composed of white collagen fibers, intertwining in every direction to form a firm and inextensible coat for the body. In the grain membrane and *cutis minor* the white fibers are supported by yellow elastic fibers. When, as in bating, the elastic fibers are removed, these two layers become soft and extensible, and the skin "falls." This is the result desired in the preparation of glove leathers, kid, and the like. But it is only necessary to bate these two upper layers. Since there is no elastin in the two basal layers, bating these latter only causes loss of valuable skin substance without any corresponding benefit.

The chemistry of lime liquors used in the tannery: W. R. ATKIN. The author has extended the theories of Procter and Wilson and of Loeb to the alkaline swelling of hide in lime liquors. The real reason why such sharpening agents as sodium sulfide and sodium carbonate produce greater swelling than lime alone is that the osmotic pressure which causes swelling is greater for sodium collagenate than for calcium collagenate at the same pH value. The smooth grain of skins unhaired in limes containing arsenic sulfide is due to the fact that calcium collagenate only is formed. A rapid method for controlling lime liquors is described. Alkaline swelling is shown to be exactly analogous to acid swelling, which has been more extensively investigated. Certain tanning processes are shown to act in a way parallel to pickling.

The determination of tannin: JOHN ARTHUR WILSON and ERWIN J. KERN. The authors have succeeded in improving the procedure of their

new method of tannin analysis. The revised procedure gives the same results as the original, but saves a great deal of time and labor and increases the accuracy for unskilled analysts. To make a determination by the revised procedure, it is necessary merely to shake a fixed amount of hide powder with a solution containing a known amount of the soluble matter of the tanning material until all tannin is removed from solution, washing the tanned powder in a special device which prevents the loss of anything but matter in solution, drying the washed powder and weighing it. The increase in weight of the dry hide powder is a measure of the tannin content. All criticism raised against the new method thus far has been refuted.

Wattle bark tannin: R. O. PHILLIPS.

Measurement of the iron contamination of chestnut extract: T. G. GREAVES.

Anthrax prophylaxis in the leather industry: ALFRED SEYMOUR-JONES. Anthrax is caused by a micro-organism which exists in two forms. It is imported by materials such as hair, bristles, wool and dried hides and skins, mainly from far eastern countries. The organism in its active form is easy to kill, but the spore is highly resistant. For wool, hair and the like, the British government has erected an experimental plant at Liverpool, using heat and formalin, which promises good results. Such treatment obviously cannot be applied to hides. Experiment has shown that with hides the only practicable method to deal with the spore is by soaking in weak acid solution. Here common disinfectants, such as formalin and the carbolic series, cannot be used, owing to their tanning action. Using mercuric chloride at 1/5000 in one per cent. formic acid, followed by a brine bath to pickle the hides, has proved very successful, and the cost should not exceed six cents a hide. Anthrax can be prevented from entering a country, as New Zealand has shown. Since 1909 there has not been a single case in the country, clearly demonstrating the efficacy of sterilizing material at the exporting port.

A trip through the tannery on the inside of a calfskin: JOHN ARTHUR WILSON. This lecture is illustrated by microscopic projections thrown on the screen at 2,000 diameters. Cross sections of calfskin at various stages of the tanning process are shown. In fleshing, the adipose tissue is cut away just under the flesh layer of elastin fibers. During liming, the substance of the Malpighian layer of the epidermis is slowly digested, thus effectively separating the corneous layer of the epidermis and the hairs from the dermis. In bating, the elastin fibers are digested by pancreatic enzymes. After bating only the grain membrane, collagen fibers, erector pili muscles and a few blood vessels are left. The tannin combines chemically with the collagen fibers. The fat liquoring process distributed oil uniformly over the surfaces of the fibers. Coloring and the application of finishing materials complete the processes of addition. Chrome tanning gives a very markedly different leather from the vegetable process.

On the hydrophobic colloid content of vegetable tanning extracts with attempts to correlate astringency with the potential difference of the particles against the aqueous phase: ARTHUR W. THOMAS and STUART B. FOSTER. The reasons for the different degrees of astringency of various vegetable tanning extracts have been long a matter for speculation. The problem has been attacked from a colloid chemical point of view with the result that astringency has been indicated to be a function of the electrical charge of the tannin particles. The higher the charge the greater is the astringency. The electrical charges for several extracts are submitted and methods of varying these charges and incidentally the astringencies of extracts are suggested. As a result of such discoveries blind use of certain vegetable extracts is no longer necessary, since the properties peculiar to one kind can be obtained with an entirely different extract by simple treatment according to the principles of colloid chemistry.

The time and concentration factors in the combination of tannin with hide substance. I. Gambier. II. Quebracho: ARTHUR W. THOMAS and MARGARET W. KELLEY. This paper is the first of a series of studies of the action of vegetable tanning extracts in the formation of leather. It brings out clearly the difference in behavior of an astringent tanning agent and of a mild one. Gambier shows slow regular increase in the amount of tans fixed by hide as the concentration of the extract and the time of reaction is increased. Contrasted to this behavior, quebracho shows a rapid and larger amount of tan fixed than gambier does, accompanied with a sharp maximum followed by an abrupt drop in the fixation. The results of this investigation combined with other researches from this laboratory are pointing to a scientific explanation of the astringency of vegetable tanning materials which will afford more intelligent control of them in the tannery.

CHARLES L. PARSONS,
Secretary.